across a mountain range as it was slowly being elevated, and continued its course far out into what is now the present ocean, to a point at least eighty miles eastward of Long Island. In late geologic time a downward movement of the earth's crust, too insignificant to be noticed in comparison with the whole diameter of the earth, has brought the former mouth of the river below sea level, and the salt water gradually encroaching has filled the broad valley where now is the important harbor of New York, and has made possible ocean navigation far inland. The influence of this easy route of communication up to the site of the present city of Albany, and from that point by easy paths up the broad Mohawk to the Great Lakes, determined the history, not only of New York State, but of the people of the continent, and has resulted in making this state the richest of the American Union.

F. H. NEWELL.

PETROGRAPHY.

The Volcanics of San Clemente. — San Clemente Island, off the coast of Southern California, is built up[1] almost exclusively of lava flows, volcanic breccias, and ash deposits. The principal eruptive is a pyroxene-andesite. In addition to this, there are smaller areas of rhyolite and dacite. The andesite consists of a mediumly basic plagioclase, augite, often hypersthene and magnetite as phenocrysts in a ground mass composed of the same minerals, with a larger or smaller proportion of glass. The dacite lies above the andesite, and the rhyolite above the dacite. The former rock contains the same phenocrysts as the andesite, but in the ground mass there is considerable quartz intergrown with oligoclase in micropoicilitic patches, and a large quantity of orthoclase, likewise in micropoicilitic intergrowths with the same plagioclase. The quartz and orthoclase appear to form the matrices in which laths of the plagioclase are imbedded.

The rhyolite is of an unusual type. It comprises phenocrysts of andesine, a few of hypersthene and magnetite, and an occasional one of augite in a microgranular and glassy matrix. The crystalline portion of the matrix is composed of quartz, orthoclase, and andesine, forming bands and lenses separated from one another by bands of glass.

[1] Smith, W. S. T. *Eighteenth Ann. Rep. U. S. Geol. Survey, 1898*, Pt. ii, p. 459.

The approximate composition of the rhyolite (I) and of the andesite (II) is as follows:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	Na_2O	K_2O	Ign.	Tot.
I.	70.39	14.09	.53	2.12	3.08	.62	3.70	3.51	2.50 =	100.54
II.	66.85	14.08		3.06	4.69	.91	3.80	2.57	2.07 =	98.03

Contact Phenomena in Michigan. — Between the graywackes, slates, etc., of the Mansfield formation, in the Crystal Falls district of Upper Michigan, and a mass of diabases on their flank, is a contact zone of dense hornstone-like rocks that have been studied by Clements.[1] As the intrusives are approached the graywackes and slates are changed into spilosites, desmosites, and finally adinoles.

The unchanged clay-slates are banded rocks composed of quartz, muscovite, rutile, hematite, and an occasional needle of actinolite in a mass of feldspathic dust. With these are phyllites, which differ from the slates in being richer in muscovite, and in containing no feldspathic interstitial substance. The contact rocks consist of quartz, albite, biotite, chlorite, muscovite, actinolite, rutile, epidote, and iron oxides. The spilosites are mottled, the spots usually being richer in chlorite than the surrounding matrix. In the few instances in which the spots are lighter colored, they are composed predominantly of feldspar. The desmosites are like the spilosites, except that the spots are united into bands. In the adinoles actinolite is the chief colored constituent, while in the spilosites and desmosites chlorite plays this rôle. The chemical relationships existing between the unchanged and the altered rocks are shown by the following analyses (in addition to the constituents indicated below there are also indicated in the original small quantities of others):

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O	P_2O_5	C
I.	60.28	.69	22.61	2.53	.45	.13	1.35	5.73	.54	4.22	0.3	.97
II.	52.51	1.70	19.00	3.31	7.19	1.55	3.29	.70	6.72	3.60	.15	
III.	57.77	.92	19.35	1.29	3.37	1.71	4.35	.22	8.22	2.52	.04	
IV.	74.16	.37	11.85	.82	1.66	2.10	2.10	.15	6.57	.57	.09	

I = slate, II = spilosite, III = spilosite, IV = adinole.

Silica increases as the igneous rock is approached, and alumina and the iron oxides decrease. Moreover, the potassa, which is the predominant alkali in the unaltered slate, is replaced almost completely by soda in the altered forms. The clay-slate is clearly clastic; the altered rocks are entirely crystallized. The former contains no albite, while the latter are rich in it. It appears that, in

[1] *Amer. Journ. Sci.*, 1899, p. 81.